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March 16, 1984

Mr. James P. O'Reilly, Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30303

Re: Catawba Nuclear Station
Unit 1
Docket No. 50-413

Dear Mr. O'Reilly:

Please find attached a revised final report on Significant Deficiency No. 413/82-07. Additional information has been incorporated into the text of the final report of August 3, 1982 as identified in the margins. Please note that the corrective actions have not been revised and that all actions have been completed as committed.

Very truly yours,

H.B. Tucker 1/100

Hal B. Tucker

LTP/php

Attachment

cc: Director
Office of Inspection & Enforcement
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

NRC Resident Inspector
Catawba Nuclear Station

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REPORT NUMBER: SD 413/82-07

REPORT DATE: August 3, 1982, Revised March 7, 1984

FACILITY: Catawba Nuclear Station, Unit 1

IDENTIFICATION OF DEFICIENCY: Overtorquing of ITT-Phillips concrete expansion anchors to close excessive plate to concrete gaps on pipe supports. Identified on February 10, 1982.

INITIAL REPORT: Mr. H. Dance of NRC Region II was notified on March 3, 1982, by W. O. Henry, Duke Power Company, 422 S. Church Street, Charlotte, NC 28242. An interim report (Number SD 413/82-07) was submitted to the NRC Region II on April 2, 1982.

COMPONENT AND/OR SUPPLIER:

Concrete expansion anchor bolts are supplied to Catawba by ITT-Phillips.

DESCRIPTION OF DEFICIENCY:

Routine QC inspections identified concrete expansion anchors which had apparently been overtorqued. This was initially discovered during the inspection of pipe support 1-A-NB-8332. In this case, QC inspections had originally identified an excessive plate to concrete gap. Upon a reinspection it was discovered that the gap no longer existed. The torque on the concrete anchors used to attach the base plate to concrete was checked and was found to be in excess of the installation torque specified in construction procedures. An attempt to reduce the plate to concrete gap had been made by overtorquing the anchors to bring the plate against the concrete. Subsequent routine inspections of other pipe supports found similar resolutions of excessive plate to concrete gaps. As a result, a sampling program was undertaken to determine the extent of overtorquing on piping support plate anchors. The sample consisted of 12 supports from each of the 13 foremen responsible for hanger erection during the period in question. These supports were inspected for anchor torque and damaged concrete. The sampling resulted in the identification of additional anchors which had measured torques higher than specified installation torques. Also, the sampling program revealed a number of anchors with measured torques below specified installation torques. No cases of damaged concrete because of overtorquing were detected.

The method to check torques on the anchors was to use a dial indicating torque wrench and turn the nut in the direction of tightening. The torque at which the nut turned (the "breakaway" torque) was assumed to be the torque at which the anchor was installed.

The sampling program detected one anchor with a cupped washer, one case of excessive gap behind the base plate, and one case of chipped concrete behind a base plate.

The sampling described above was documented on nonconforming item 14069.

After NCI 14069 was written, QA began requiring a check of maximum torque as a part of its routine hanger inspection. This was done until Design

Engineering advised Construction that checking of maximum torque was not required. As a result of adding maximum torque to the inspection, additional anchors suspected of being overtorqued were detected and documented on NCI 14403 and NCI 14404.

ANALYSIS OF SAFETY IMPLICATIONS: Excessive overtorquing may break an anchor or overstress it such that its ability to carry its design load is diminished. Minimum embedment may be violated due to the anchor being pulled too far up in its hole or the concrete around the anchor may be damaged due to high expansion forces. These items may lead to failure of pipe supports which could impair safe operation of the plant.

It should be noted that the torque values given in the anchor installation specification are for installation only. These torques are specified to assure that the anchor is properly set. Only a check of minimum torque is required to assure that the anchor has been properly set.

Checking torque on an anchor at a time after the intial installation is only an approximate check of the actual installation torque. Several factors will affect the torque readings obtained. These factors include anchor relaxation, base plate flexing due to torquing of adjacent anchors, corrosion of bolt material, presence of dust or moisture, and applied loads. Therefore, it is questionable that the "breakaway" torques recorded by QC in their inspections are representative of the actual installation torque. However, to ensure that the apparently overtorqued anchors are not a safety hazard, evaluation of the torque-tension relationship was necessary. For evaluation purposes, the "breakaway" torques reported by QC were considered as actual installation torques.

A series of tests was conducted to evaluate the stress conditions in the anchors due to the possible overtorquing. The anchors tested were identical to those in use at Catawba. A brief description and summary of the tests follow:

1) Test: Anchors installed in concrete were torqued until the anchor broke or it slipped to the point that minimum embedment was violated. The test sample include 1/2", 5/8", and 3/4" diameter sleeve anchors.

   Results: No anchors broke at torque levels lower than QC inspectors found in the field installations. However, 13% of the anchors slipped to less than minimum embedment at torques lower than those found in the field.

   (Note: None of the existing anchors inspected by QC were broken or showed any signs of damage.)

2) Test: Anchors installed in concrete were overtorqued to predetermined levels (comparable to the measured "breakaway" levels) and then tension tested until failure. This test was to determine what effect overtorquing would have on pullout values. The test sample include 1/2", 5/8", and 3/4" diameter sleeve anchors.

   Results: Pullout capacities showed an increase when installation torques were increased.

3) Test: Anchors installed in concrete were installed per construction procedures and the torque checked for several days thereafter. This test was to show if consistent torque readings could be obtained. The test sample included 1/2", 5/8" and 3/4" diameter sleeve anchor.

Results: Torque readings over the test period varied ± 25%.

4) Test: Anchors installed in concrete were overtorqued to predetermined levels (comparable to the measured "breakaway" torque levels) while the anchor tension was monitored. This was done using strain gage force washers and digital readout equipment. The test sample included 1/2", 5/8", and 3/4" diameter sleeve anchors and 7/8", 1", and 1 1/4" diameter wedge anchors.

In conjunction with this test, the yield and tensile strengths of the anchor stud material were determined through mechanical tension testing of material samples. This was done by Law Engineering Testing Company, Charlotte, NC.

Results: As expected, the torque-tension relationships shown in these tests were variable. But in no case were bolt stud tensile stresses greater than the tensile yield strength of the anchor stud. Some of the anchors did break during torquing even though anchor stud stresses were below expected tensile yield. The breakage occurred in all of the 1/2" and 5/8" diameter sleeve anchors and in 25% of the 3/4" diameter sleeve anchors. In every case, fracture occurred in the threaded portion of the anchor stud. This breakage indicated that torsional shear due to torquing is as significant as tension in causing the stud to fail. The torques at which the anchors broke were equivalent to or lower than some of those found by QC inspections.

Although none of the anchors inspected were broken, these test results indicate that some of the anchor studs may be stressed beyond the yield point.

For all other anchors tested, the torques used for testing caused no breakage and were much higher than any torques found in field installations.

Based on the results of the above testing, acceptance criteria for maximum allowable torque values were established. Out of 397 supports inspected with approximately 1650 anchors, 18 of the anchors on 14 supports did not meet the acceptance criteria. Eight of these anchors (on 7 supports) were identified under NCI 14069. Ten anchors (on 7 supports) were identified under NCI 14404. No unacceptable anchors were found under NCI 14403. Calculations were performed assuming the 18 anchors not meeting the acceptance had failed. The results were that the system operability would be maintained. Therefore, no significant safety problem exists with the overtorqued anchors.

In the case of those anchors which were undertorqued, there were 9 anchors on 5 supports which were torqued below specified limits. All of these anchors were identified under NCI 14069. Calculations were performed assuming the 9 undertorqued anchors as being ineffective. The results showed that system operability would be maintained. Therefore, no significant safety problem exists.

Those anchors identified under NCI 14069 as having a cupped washer, insufficient bearing, and chipped concrete were evaluated under NCI 16188 and were determined to present no significant safety problem.

Of those anchors identified under NCI 14069 as being overtorqued, none were found to be broken or to have damaged concrete. Of those anchors identified as being overtorqued under NCI's 14403 and 14404, none were found to violate minimum embedment, none were broken, and none had damaged concrete.

CORRECTIVE ACTION:

Those anchors which did not meet the acceptance criteria for maximum torque will be replaced. Construction personnel have been retrained in the proper resolution of excessive plate to concrete gaps and the proper method for torquing of anchor bolts. Also, an inspection point will be added to QC procedures to require visual inspection of concrete around expansion anchors to detect any distress in the concrete which may have resulted from overtorquing of the anchors. Those anchors which were undertorqued will be retorqued to the proper specifications. These corrective actions will be completed by January 15, 1983 as part of an existing reinspection/correction program.